

What is claimed is:

1. Textured yarns having from 1 to 100 crimps/inch derived from melt processable perfluoropolymers, having individual filament deniers from about 0.5 to about 300, and total yarn deniers of about 10 to 100,000, wherein said perfluoropolymer is selected from the group consisting of copolymers of tetrafluoroethylene with 1 to 5 mole % of at least one perfluoroalkoxylvinylether, where the alkyl group has from 1 to 4 carbon atoms, and copolymers of tetrafluoroethylene with 2 to 20 mole% of at least one perfluoroolefin having from 3 to 8 carbon atoms.

2. Staple fibers having from 1 to 50 crimps/inch derived from melt processable perfluoropolymers, having individual filament deniers from about 0.5 to about 300, and total yarn deniers of about 10 to 100,000, wherein said perfluoropolymer is selected from the group consisting of copolymers of tetrafluoroethylene with 1 to 5 mole % of at least one perfluoroalkoxylvinylether, where the alkyl group has from 1 to 4 carbon atoms, and copolymers of tetrafluoroethylene with 2 to 20 mole% of at least one perfluoroolefin having from 3 to 8 carbon atoms.

3. Single component and multicomponent yarns and staple fibers having from 1 to 100 crimps/inch derived from melt processable perfluoropolymers, having individual filament deniers from about 0.5 to about 300, and total yarn deniers of about 10 to 100,000 and having a cross-sectional shape selected from the group consisting of circular, elliptical, angular, hollow, multilobal, sheath core, or islands-in-the sea, and in the case of multicomponent fibers containing other melt processable polymers.

4. A yarn according to claim 3 having residual elongation of 1 to 50%, excellent filament uniformity, and low brittleness.

5. A high purity yarn and staple fiber according to claim 3 suitable for use in semiconductor, pharmaceutical, and other high purity applications.

6. A yarn according to claim 3 suitable for weaving, knitting, hydroentangling, flame treating, and other textile processes.

7. An air entangled yarn according to claim 3.

8. A twisted yarn, according to claim 3, having 1 to 20 twists per inch.

9. A woven fabric having a weight per square yard of from about 1 to about 100 ounces per square yard made from flat, air entangled, or twisted yarns according to claim 3, suitable for use in filtration, and as a support scrim in non-woven products.

10. A knitted fabric having a weight per square yard of from about 1 to about 100 ounces per square yard made from flat, air entangled, or twisted yarns according to claim 3, suitable for use in filtration, and as a support scrim in non-woven products.

11. A crimped staple fiber according to claim and 3, wherein the filaments have been crimped to give an angular saw toothed shape having from 1 to 50 crimps per inch, cut to any

length, suitable for use on standard carding equipment to make nonwoven batts which can then be needled into felts, for carding into sliver for making spun yarns, or for producing high loft air laid non-woven products.

12. A non-woven perfluoropolymer fabric having a weight per square yard of from about 1 to about 100 ounces per square yard produced by <sup>method described</sup> needlepunching of a continuous, carded staple fiber web, made from staple fibers according to claim 11, having excellent strength in both the machine and cross-machine directions, and good filtration properties.

13. A lightly needled or un-needled carded <sup>nonwoven</sup> batt made from melt processable perfluoropolymer fiber according to claim 11, which has been densified and/or bonded through a heated calendering process, with smooth, textured, or patterned calender rolls, to yield a fabric with increased strength and stiffness as compared to its precursor.

14. A fabric, according to claim 12, further including a perfluoropolymer woven supporting fabric or scrim for increased strength.

15. A fabric, according to claim 12, further including a woven supporting fabric or scrim made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or synthetic fibers for increased strength.

16. A fabric according to claims 12, 14 and 15 where the fabric density, air permeability, and mean pore size can be controlled through needling conditions.

17. A calendered fabric according to claims 12, 14 or 15 where the fabric density, air permeability, and mean pore size can be controlled through the heated calendering/densification process with smooth, textured, or patterned calender rolls.

18. A fabric according to claim 12 or 13, made from a blend comprising: from 1 to 99 percent melt processable perfluoropolymer staple fibers; and 99 to 1 percent fibers selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other synthetic fibers, the fabric being made either with or without a woven support scrim made from either a perfluoropolymer or from materials selected from the group consisting of glass, aramid, polyacrylate polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or synthetic fibers, the scrim being added for increased strength, and where the fabric density, air permeability and mean pore size can be controlled through needling conditions and through the heated calendaring/densification process with smooth, textured, or patterned calender rolls.

19. A fabric according to claims 12 or 13 made from a blend comprising: 1 to 99 percent melt processable perfluoropolymer staple fibers; and 99 to 1 percent PTFE fibers, the fabric being made either with or without a woven support scrim made from either a perfluoropolymer or from materials selected from the group consisting of glass, aramid, polyacrylate polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers,

industrial chemical, pharmaceutical, and semiconductor applications, where fibers may be bonded to themselves or to other high temperature plastics, fabrics, or other media.

24. Filtration and coalescing components according to claim 22 or 23 with seams formed by thermal fusion.

25. Filtration and coalescing components according to claim 22 or 23 which are melt fused to other components of the filter or the filter housing to form a liquid tight seal.

26. Filtration and coalescing components according to claim 22 or 23 having less tendency to foul and easier cleaning by back-pulsing, rinsing, mechanical means, or other techniques.

27. Pleatable filtration and coalescing components according to claim 22 or 23.

28. Filtration and coalescing components according to claim 22 or 23 thermally bonded to other media, such as membranes, drainage layers, pleat supports and any other component of filter elements or devices.

29. A self-supported or scrim supported needlefelt derived from melt processable perfluoropolymer fibers according to claim 11, possessing a Mullen burst strength (ASTM-D3776) between 50 and 400 psi.

30. A self-supported or scrim-supported needlefelt derived from melt processable perfluoropolymer fibers according to claim 11, possessing an air permeability between 1 and 300 cfm/ft<sup>2</sup> at 0.5" water pressure.

31. A woven fabric having a weight per square yard of about 1 to about 100 ounces per square yard, made from a blend comprising: 1 to 99 percent by weight flat, air entangled, or textured yarns derived from melt processable perfluoropolymer; and 99 to 1 percent of fibers or yarns made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or other synthetic fibers, suitable for use in filtration, and as a support scrim in nonwoven products.

32. A woven fabric having a weight per square yard of about 1 to about 100 ounces per square yard, made from a blend comprising: 1 to 99 percent by weight flat, air entangled, or textured yarns derived from melt processable perfluoropolymer; and 99 to 1 percent by weight of fibers or yarns made from polytetrafluoroethylene (PTFE), suitable for use in filtration, and as a support scrim in nonwoven products.

33. A knitted fabric having a weight per square yard of about 1 to about 100 ounces per square yard, made from a blend comprising: 1 to 99 percent by weight flat, air entangled, or textured yarns derived from melt processable perfluoropolymer; and 99 to 1 percent of fibers or yarns made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon,

or other natural or other synthetic fibers, suitable for use in filtration, and as a support scrim in nonwoven products.

34. A knitted fabric having a weight per square yard of about 1 to about 100 ounces per square yard, made from a blend comprising: 1 to 99 percent by weight flat, air entangled, or textured yarns derived from melt processable perfluoropolymer; and 99 to 1 percent by weight of fibers or yarns made from polytetrafluoroethylene (PTFE), suitable for use in filtration, and as a support scrim in nonwoven products.

35. Flat, air entangled, and twisted yarns, staple fibers, and woven, knit, and nonwoven fabrics made with or without woven support scrims, derived from a blend comprising: 1 to 99 percent by melt processable perfluoropolymer fibers or yarns; and 99 to 1 percent of fibers or yarns made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or other synthetic fibers, which are thermally bonded to themselves.

36. Flat, air entangled, and twisted yarns, staple fibers, and woven, knit, and nonwoven fabrics made with or without woven support scrims, derived from a blend comprising: 1 to 99 percent by melt processable perfluoropolymer fibers or yarns; and 99 to 1 percent of fibers or yarns made from polytetrafluoroethylene (PTFE), which are thermally bonded to themselves.

37. Flat, air entangled, and twisted yarns, staple fibers, and woven, knit, and nonwoven fabrics made with or without woven support scrims, derived from a blend comprising: 1 to 99

carbon, or other natural or synthetic fibers, the scrim being added for increased strength and where the fabric density, air permeability and mean pore size can be controlled through needling conditions and through the heated calendaring/densification process with smooth, textured, or patterned calender rolls.

20. Flat, air entangled and twisted yarns, staple fibers, and woven, knit and nonwoven fabrics made with or without woven support scrims, derived from melt processable perfluoropolymers, which are thermally bonded to themselves.

21. Flat, air entangled and twisted yarns, staple fibers, and woven, knit and nonwoven fabrics made with or without woven support scrims, derived from melt processable perfluoropolymers, thermally bonded to other high temperature plastics, fabrics and other media.

22. Filtration and coalescing media, support layers, drainage layers, and other components produced by winding continuous or spun flat, air entangled, or textured yarns derived from melt processable perfluoropolymers, with purity sufficient for industrial chemical, pharmaceutical, and semiconductor applications, where fibers may be bonded to themselves or to other high temperature plastics, fabrics, or other media.

23. Filtration and coalescing media, support layers, drainage layers, and other components produced from woven, knit and nonwoven fabrics made with or without woven support scrims, derived from melt processable perfluoropolymer yarns and fibers, with purity sufficient for



percent by melt processable perfluoropolymer fibers or yarns; and 99 to 1 percent of fibers or yarns made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or other synthetic fibers, which are thermally bonded to other high temperature plastics, fabrics and other media.

38. Flat, air entangled, and twisted yarns, staple fibers, and woven, knit, and nonwoven fabrics made with or without woven support scrims, derived from a blend comprising: 1 to 99 percent by melt processable perfluoropolymer fibers or yarns; and 99 to 1 percent of fibers or yarns made from polytetrafluoroethylene (PTFE), which are thermally bonded to other high temperature plastics, fabrics and other media.

39. Filtration and coalescing media, support layers, drainage layers, and other components produced by winding continuous or spun yarns, made from a blend comprising: 1 to 99 percent melt processable perfluoropolymer yarns or fibers; and 99 to 1 percent by weight of fibers or yarns made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or other synthetic fibers.

40. Filtration and coalescing media, support layers, drainage layers, and other components produced by winding continuous or spun yarns, made from a blend comprising: from 1 to 99 percent melt processable perfluoropolymer yarns or fibers; and 99 to 1 percent PTFE yarns or fibers.

41. Filtration and coalescing media, support layers, drainage layers, and other components produced from woven, knit and nonwoven fabrics made with or without woven support scrims, made from a blend comprising: from 1 to 99 percent melt processable perfluoropolymer yarns or fibers; and 99 to 1 percent by weight of fibers or yarns made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or other synthetic fibers, where the fibers and forms many or may not be thermally bonded to themselves or other components in the filter assembly, with purity suitable for the industrial chemical, pharmaceutical, and semiconductor industries.

42. Filtration and coalescing media, support layers, drainage layers, and other components produced from woven, knit and nonwoven fabrics made with or without woven support scrims, made from a blend comprising: from 1 to 99 percent melt processable perfluoropolymer yarns or fibers; and 99 to 1 percent PTFE yarns or fibers, where the fibers and forms many or may not be thermally bonded to themselves or other components in the filter assembly, with purity suitable for the industrial chemical, pharmaceutical, and semiconductor industries.

43. Filtration and coalescing components according to claim 39, 40, 41 or 42 with seams formed by thermal fusion.

44. Filtration and coalescing components according to claim 39, 40, 41 or 42 which are melt fused to other components of the filter or the filter housing to form a liquid tight seal.

45. Filtration and coalescing components according to claim 39, 40, 41, or 42 having less tendency to foul and easier cleaning by back-pulsing, rinsing, mechanical means, or other techniques.

46. Pleatable filtration and coalescing components according to claim 39, 40, 41 or 42.

47. Filtration and coalescing components according to claim 39, 40, 41 or 42 thermally bonded to other media, such as membranes, drainage layers, pleat supports and any other component of filter elements or devices.

48. A self-supported or scrim supported needlefelt made from a blend comprising: from 1 to 99 percent melt processable perfluoropolymer fibers according to claim 11; and 99 to 1 percent fibers made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or other synthetic fibers, said needlefelt possessing a Mullen burst strength (ASTM-D3776) between 50 and 400 psi.

49. A self-supported or scrim supported needlefelt made from a blend comprising: from 1 to 99 percent melt processable perfluoropolymer fibers according to claim 11; and from 99 to 1

percent PTFE fibers, said needlefelt possessing a Mullen burst strength (ASTM-D3776) between 50 and 400 psi.

50. A self-supported or scrim supported needlefelt made from a blend comprising: from 1 to 99 percent by weight of melt processable perfluoropolymer fibers according to claim 11; and 99 to 1 percent by weight fibers made from materials selected from the group consisting of glass, aramid, polyacrylate, polyphenylene sulfide, polyimide, polyester, polyamide, partially fluorinated polymers, carbon, or other natural or other synthetic fibers, said self supported or scrim supported needlefelt possessing an air permeability between 1 and 300 cfm/ft<sup>2</sup> at 0.5" water pressure.

51. A self-supported or scrim supported needlefelt made from a blend comprising: from 1 to 99 percent by weight of melt processable perfluoropolymer fibers according to claim 11; and 99 to 1 percent PTFE fibers, said self-supported or scrim supported needlefelt possessing an air permeability between 1 and 300 cfm/ft<sup>2</sup> at 0.5" water pressure.

52. Filtration and coalescing components containing melt processable perfluoropolymer fibers, either alone, blended with other fibers or mixed with other materials, with seams formed by sewing, use of an adhesive, or by mechanical fasteners.

53. Filtration and coalescing components containing melt processable perfluoropolymer fibers, either alone, blended with other fibers or mixed with other materials, which are attached

to other components of the filter or the filter housing, using an adhesive, to form a liquid tight seal.

54. Filtration and coalescing components containing melt processable perfluoropolymer fibers, either alone, blended with other fibers or mixed with other materials, attached to other media, such as membranes, drainage layers, pleat supports and any other component of filter element devices using an adhesive, by sewing, or by mechanical fasteners.

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